

What is claimed is:

1. A method for determining a number of compressors to start in a multiple compressor chiller system, the method comprising the steps of:

providing a multiple compressor chiller system having a predetermined number of compressors and a variable speed drive, the variable speed drive having a predetermined number of inverters, wherein each inverter is configured to power a corresponding motor of a compressor;

designating a number of inverters to be enabled on startup of the multiple compressor chiller system, wherein the designated number of inverters to be enabled on startup being initially equal to the predetermined number of inverters, and wherein enabling of an inverter at startup of the multiple compressor chiller system starts a corresponding compressor;

determining whether at least one predetermined criteria related to conditions of the multiple compressor chiller system is satisfied; and

reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to a determination that a predetermined criteria has been satisfied.

2. The method of claim 1 further comprising the step of repeating, for each predetermined criteria, the steps of determining whether at least one predetermined criteria related to conditions of the multiple compressor chiller system is satisfied and reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to a determination that a predetermined criteria has been satisfied.

3. The method of claim 2 wherein:

the step of determining whether at least one predetermined criteria related to conditions of the multiple compressor chiller system is satisfied includes the step of determining whether a last operating time period for the multiple compressor chiller system is less than a first predetermined time period; and

the step of reducing the designated number of inverters to be enabled on startup includes the step of reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to the last operating time period for the multiple compressor chiller system being less than the first predetermined time period.

4. The method of claim 3 wherein the first predetermined time period is a time period between about one minute and about thirty minutes.

5. The method of claim 4 wherein the first predetermined time period is about five minutes.

6. The method of claim 2 wherein:

the step of determining whether at least one predetermined criteria related to conditions of the multiple compressor chiller system is satisfied further includes the step of determining whether a shutdown time period for the multiple compressor chiller system is less than a second predetermined time period; and

the step of reducing the designated number of inverters to be enabled on startup further includes the step of reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to the shutdown time period for the multiple compressor chiller system being less than the second predetermined time period.

7. The method of claim 6 wherein the second predetermined time period is a time period between about one minute and about thirty minutes.

8. The method of claim 7 wherein the second predetermined time period is about five minutes.

9. The method of claim 2 wherein:

the step of determining whether at least one predetermined criteria related to conditions of the multiple compressor chiller system is satisfied further includes the steps of:

determining whether a leaving chilled liquid temperature for the multiple compressor chiller system is less than a predetermined temperature; and

determining whether a leaving chilled liquid temperature rate of change for the multiple compressor chiller system is less than a predetermined leaving chilled liquid temperature rate of change; and

the step of reducing the designated number of inverters to be enabled on startup further includes the step of reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to the leaving chilled liquid temperature for the multiple compressor chiller system being less than the predetermined temperature and the leaving chilled liquid temperature rate

of change for the multiple compressor chiller system being less than the predetermined leaving chilled liquid temperature rate of change.

10. The method of claim 9 wherein the predetermined leaving chilled liquid temperature rate of change is a rate of change between about 1° F/min. and about 5 ° F/min.
11. The method of claim 10 wherein the predetermined leaving chilled liquid temperature rate of change is about 3 ° F/min.
12. The method of claim 11 wherein the predetermined temperature is a control range temperature plus a predetermined offset temperature.
13. The method of claim 12 wherein:
 - the control range temperature is a temperature between about 38 ° F and about 52 ° F; and
 - the predetermined offset temperature is a temperature between about 1 ° F and about 10 ° F.
14. The method of claim 2 wherein the designated number of inverters to be enabled is at least one inverter.
15. The method of claim 2 wherein the step of reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to a determination that a predetermined criteria has been satisfied includes the step of reducing the designated number of inverters to be enabled on startup by one inverter in response to a determination that a predetermined criteria has been satisfied.
16. The method of claim 1 wherein:
 - the step of determining whether at least one predetermined criteria related to conditions of the multiple compressor chiller system is satisfied includes the steps of:
 - determining whether a last operating time period for the multiple compressor chiller system is less than a first predetermined time period;
 - determining whether a shutdown time period for the multiple compressor chiller system is less than a second predetermined time period;
 - determining whether a leaving chilled liquid temperature for the multiple compressor chiller system is less than a predetermined temperature; and

determining whether a leaving chilled liquid temperature rate of change for the multiple compressor chiller system is less than a predetermined leaving chilled liquid temperature rate of change; and

the step of reducing the designated number of inverters to be enabled on startup includes the steps of:

reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to the last operating time period for the multiple compressor chiller system being less than the first predetermined time period;

reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to the shutdown time period for the multiple compressor chiller system being less than the second predetermined time period; and

reducing the designated number of inverters to be enabled on startup by a predetermined amount in response to the leaving chilled liquid temperature for the multiple compressor chiller system being less than the predetermined temperature and the leaving chilled liquid temperature rate of change for the multiple compressor chiller system being less than the predetermined leaving chilled liquid temperature rate of change.

17. A multiple compressor chiller system comprising:

a plurality of compressors, each compressor of the plurality of compressors being driven by a corresponding motor, the plurality of compressors being incorporated into at least one refrigerant circuit, each refrigerant circuit comprising at least one compressor of the plurality of compressors, a condenser arrangement and an evaporator arrangement connected in a closed refrigerant loop;

a variable speed drive to power the corresponding motors of the plurality of compressors, the variable speed drive comprising a converter stage, a DC link stage and an inverter stage, the inverter stage having a plurality of inverters, each inverter being electrically connected in parallel to the DC link stage and each inverter powering a corresponding motor of the plurality of compressors; and

a control panel comprising a microprocessor and a memory device storing at least one control program, the control panel being configured to determine a

number of compressors of the plurality of compressors to start on a startup of the multiple compressor chiller system, the control panel comprising means for designating at least one compressor of the plurality of compressors as the number of compressors of the plurality of compressors to start, means for evaluating at least one predetermined criteria related to system conditions, and means for adjusting the number of compressors of the plurality of compressors to start by a predetermined amount in response to satisfying a predetermined criteria.

18. The multiple compressor chiller system of claim 17 wherein the at least one predetermined criteria related to system conditions comprise a plurality of predetermined conditions related to system conditions, the plurality of predetermined conditions comprising:

a last operating time period for the multiple compressor chiller system being less than a first predetermined time period;

a shutdown time period for the multiple compressor chiller system being less than a second predetermined time period;

a leaving chilled liquid temperature for the evaporator arrangement being less than a predetermined temperature; and

a leaving chilled liquid temperature rate of change for the evaporator arrangement being less than a predetermined leaving chilled liquid temperature rate of change.

19. The method of claim 18 wherein the first predetermined time period is a time period between about one minute and about thirty minutes.
20. The method of claim 19 wherein the first predetermined time period is about five minutes.
21. The method of claim 18 wherein the second predetermined time period is a time period between about one minute and about thirty minutes.
22. The method of claim 21 wherein the second predetermined time period is about five minutes.
23. The method of claim 18 wherein the predetermined leaving chilled liquid temperature rate of change is a rate of change between about 1° F/min. and about 5 ° F/min.
24. The method of claim 23 wherein the predetermined leaving chilled liquid temperature rate of change is about 3 ° F/min.

25. The method of claim 18 wherein the predetermined temperature is a control range temperature plus a predetermined offset temperature.

26. The method of claim 25 wherein:

the control range temperature is a temperature between about 38 ° F and about 52 ° F; and

the predetermined offset temperature is a temperature between about 1 ° F and about 10 ° F.